

**LUMICON**

**2111 Research Drive  
Livermore, CA. 94550  
(415) 447-9570**



**LUMICON**

**"Innovation in Astronomy"**

# *Owner's Manual*

## Lumicon Dual and Digital Quartz Star Drives

Lumicon  
2111 Research Drive  
Livermore, California 94550

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# TABLE of CONTENTS

| Chapter Title                       | Page |
|-------------------------------------|------|
| INTRODUCTION . . . . .              | 1    |
| FEATURES . . . . .                  | 3    |
| Dual Star Drive . . . . .           | 4    |
| Digital Quartz Star Drive . . . . . | 5    |
| OPTIONS                             |      |
| Declination Motor . . . . .         | 6    |
| 120 VAC Synchronous AC . . . . .    | 7    |
| 24 VDC Declination . . . . .        | 7    |
| LED Package . . . . .               | 7    |
| POLAR ALIGNMENT. . . . .            | 8    |
| FLEXURE. . . . .                    | 10   |
| GUIDING. . . . .                    | 10   |
| PRECAUTIONS. . . . .                | 12   |
| <u>DUAL STAR DRIVE</u>              |      |
| Cabling . . . . .                   | 13   |
| Operation . . . . .                 | 13   |
| Calibration. . . . .                | 14   |
| Circuit Description. . . . .        | 15   |
| Parts List . . . . .                | 17   |
| Schematic. . . . .                  | 19   |
| Circuit Board Artwork. . . . .      | 20   |
| <u>DIGITAL QUARTZ STAR DRIVE</u>    |      |
| Cabling . . . . .                   | 21   |
| Operation . . . . .                 | 22   |
| Circuit Description. . . . .        | 24   |
| Parts List . . . . .                | 26   |
| Schematic. . . . .                  | 28   |
| Circuit Board Artwork. . . . .      | 29   |
| SPECIFICATIONS . . . . .            | 30   |
| SERVICE. . . . .                    | 31   |
| WARRANTY . . . . .                  | 31   |

## INTRODUCTION

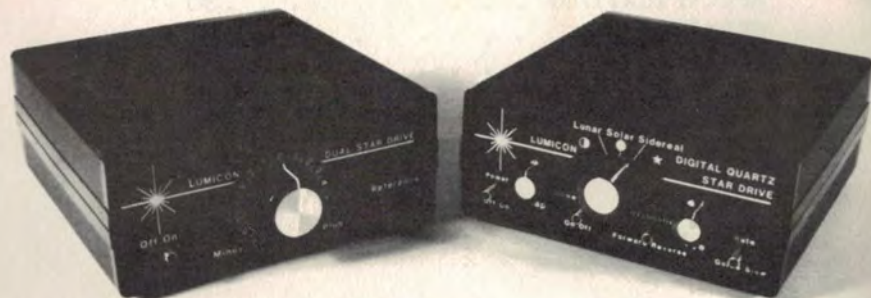
Lumicon Star Drives have two main functions. The first is to power your telescope motor from a 12 V battery. If you are planning to make field trips, where no household current is available, you'll need a Lumicon Star Drive. While on that far away mountain top, a Lumicon Star Drive plugged into your car cigar lighter will power the clock drive motor for pleasant viewing. You'll enjoy the dark skys that the Lumicon Star Drive permits using.

The second function is for astro-photographers. Long time exposures require precise tracking, or the resulting photograph will be smeared. Clock drive motors do a fine job, but errors creep in. The changing position of the telescope effects mechanical alignment of the optics. Power line frequency does vary. Atmospheric refraction causes apparent speed fluctuations. And there are irregularities in the motor and gearing.

Lumicon Star Drives allow you to make corrections electronically. Use the pushbutton switches to keep a "guide star" centered on the crosshairs of your tracking telescope. Depending on your optics and film the guide star can drift from one half to two star diameters, before the film will see the difference. With Lumicon Star Drives, your astrophotographs should have pin point images.

*Lumicon Dual Star Drive*

*Lumicon Digital Star Drive*



Lumicon Star Drives come with probalbly the smallest and most comfortable to use controls on the market. The compact size and ultra-light weight of the Switch Pod allows comfortable one hand operation. This allows you to use the Switch Pod with your hands snug and warm in your coat pocket on those cold nights. Even a "miniature" joystick requires one hand to hold the control and the other to handle the stick.

Switches allow precise corrections to be made, since digital quartz generation or precision resistors and other timing components can be used. Corrective movement stops instantly upon release of the switch with no danger of "off center creep".

*Lumicon Switch Pod*



## FEATURES

Drive electronics are enclosed in an impact-resistant, black plastic case for long life and attractive appearance.

Input circuitry protects against voltage transient spikes, and reverse voltage hook-up.

A heavily filtered and highly regulated power supply prevents input voltage changes from effecting the output.

Power FETs and robust power transistors mounted on massive heatsins drive the output transformer.

Rugged PC mount transformers, actually rated for 24 Watts, are down rated to 15 Watts for cooler operation and longer trouble-free life. And for extra ruggedness the transformers are bolted to the PC Board.

Both power cords and even the Switch Pod are fully detachable for easy pack-up and transportation.

Extra long, 12 foot DC power cord for greater convenience in positioning the telescope.

Dual voltage operation from either household 120 VAC or your car's 12 VDC battery with "bumpless" transfer to battery operation in the event of an AC power loss.

A reversing switch allows use of erecting prisms without backwards controls.

Declination drive eliminates the requirement for a perfect polar alignment when used with the optional Declination Motor. Dynamic braking on the declination drive prevents the motor from coasting to a stop.

All units undergo a 24 hour full load burn-in and are backed-up by a full one year warranty.

## Dual Star Drive

Precision one percent timing components are used for stability.

Front panel vernier is calibrated by an internal potentiometer.

Quartz crystal generated frequency of 60.000 Hertz for reference in obtaining the correct output drive frequency.

MAP LED output with fixed output voltage.

### Lumicon Dual Star Drive



## D i g i t a l   Q u a r t z   S t a r   D r i v e

Quartz crystal generated frequencies of LUNAR, SOLAR, and SIDEREAL. Each plus or minus delta, where delta is the difference between solar and sidereal. These are digital quartz crystal generated frequencies as stable as the crystal. Even the one percent resistors & capacitors used in the standard unit will drift slightly with temperature and must be corrected to the crystal reference by the observer. *CUSTOMIZED IC's* are used for the crystal controlled digital frequency generation.

Quartz crystal generated frequencies of GUIDE EAST & WEST of 40.000 & 80.000 Hz. and SLEW EAST & WEST of 0.000 & 105.00 Hz.

Front panel POWER SAVER switch to select between C8, M2080 size telescopes and larger telescopes. This lowers the current draw for the smaller sizes for longer battery life.

Illuminated reticle eyepiece LED output jack and control. Map, R.A. and DEC setting circle LED outputs with one control.



## O P T I O N S

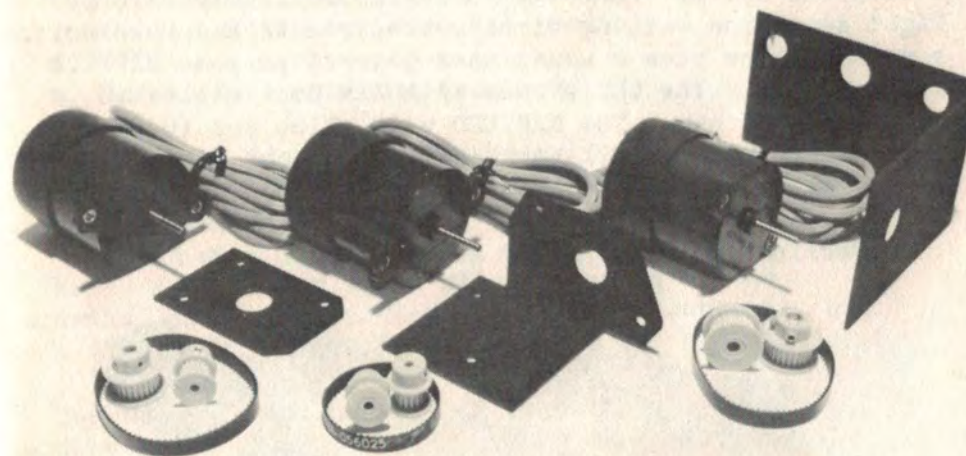
### D e c l i n a t i o n   M o t o r

A powerful 12VDC motor coupled to Posi-Drive timing pulleys and drive belt provides 65 inch-pounds to rotate your declination adjustment shaft. This motor is the perfect match for the Lumicon Star Drive and comes with a mounting bracket for either Celestron SC8, Meade 2080 or 826. The Celestron bracket requires two holes to be drilled in the yoke. Please specify telescope when ordering.

*Celestron SC8*

*Meade 2080*

*Meade 826*



## 120 VAC Synchronous AC 24 VDC Declination Output

Lumicon has two additional declination output options. The first is for telescope owners who have 24 VDC declination motors. The second is for telescope owners who have 120 VAC synchronous declination motors. The 120 VAC model requires soldering supplied connectors to your telescope drive. Please specify brand and model of synchronous motor for correct starting capacitors. Complete wiring diagrams are provided. If purchasing either of these options after purchase of either the Digital Quartz or Dual Star Drive, the drive unit must be returned for proper option installation.

### LED Package

A complete set of two LED's for your Declination & Right Ascension setting circles complete with convenient mounting clips plus a additional general purpose MAP LED is available. The LED's come with six foot cables to allow ease of use. The MAP LED will allow you to read your charts without a flashlight and the red light will not harm your night vision.

Declination LED    Right Ascension LED    Map LED



## POLAR ALIGNMENT

This procedure is not required; provided corrections are made using the North South buttons on the Switch Pod. But the better the alignment, the fewer corrections.

1. Roughly aim the telescope's polar axis north.
2. Find a star slightly north of the celestial equator (near zero degrees Declination) and near the meridian.
3. Use the illuminated reticle eyepiece at normal guiding magnification and track the star, keeping it centered in right ascension.
4. The direction of the drift indicates the direction to correct for azimuth. \* (See Note below):
  - a. North drift-move the axis east.
  - b. South drift-move the axis west.
5. Repeat this process until the drift is no more than a few seconds of arc over a half hour. The axis is now aligned in azimuth.
6. Next, find a star again slightly north of the celestial equator (near zero degrees Declination), but this time near the eastern horizon.
7. Use the illuminated reticle eyepiece at normal guiding magnification and track the star, keeping it centered in right ascension.

\* Note: For telescopes using German Equatorial Mounts these corrections can be reversed, depending on whether the telescope tube is on the West or East side of the mount. Always move the polar axis to decrease drift in declination.

8. The direction of the drift indicates the direction to correct for elevation. \* (See Note above):

- a. North drift-move the axis down.
- b. South drift-move the axis up.

9. Repeat this process until the drift is no more than a few seconds of arc over a half hour. The axis is now aligned in elevation.

10. The azimuth procedure may need to be repeated if the elevation correction was large.

## FLEXURE

Your telescope should be checked for flexure. Flexure is the movement any one part of the telescope optics relative to another. The amount can be just a few thousandths of an inch, and won't be noticed until your film is processed. The guide telescope may make a small movement due to sag of the main telescope tube. The main mirror or secondary vane spider might shift slightly. The camera may flex on the focuser.

The only reliable and permanent cure for flexure is off-axis guiding. Therefore Lumicon strongly recommends that serious astrophotographers consider use of an off-axis guider, such as the LUMICON EASY-GUIDER. Then any flexure is automatically corrected. A separate guide-scope is helpful for comet photography. However, for all deep-sky photography, off-axis guiding always yields more consistent and reliable results. Call or write Dr. Jack Marling at LUMICON for any technical questions about astrophotography.

## GUIDING

There are several points to guiding. First, in almost all cases the reticle cross hairs should be oriented in the same direction as right ascension and declination. Check this by pressing the control buttons. Lumicon highly recommends the use of Guiding eyepieces with dual crosslines which form a box. These are available from LUMICON, Meade, and others. Dim stars can be centered in the box and are thus easier to see. Second. The star image in the guiding eyepiece should be in sharp focus. This makes dim stars easier to see. More importantly it eliminates parallax guiding errors. The position of an out-of-focus star could move when your eye moves, ruining guiding accuracy.

The required guiding magnification is 8-12X the photographic magnification. Since 35mm cameras have the

same magnification as a 50mm eyepiece, the proper guiding magnification is determined by dividing the focal length of the photographic optics by 4-6mm. Thus for an 8" f/6 telescope the proper guiding magnification is  $1200\text{mm}/4\text{mm} = 300\text{X}$ . At this magnification you will get a perfectly guided photo if the star image stays within the box for dual crossline guiding eyepieces. For the recommended off-axis guiding, the main telescope is also the guide-scope. Thus the proper guiding magnification is automatically achieved by using a 2X - 3X Barlow with the common 12mm guiding eyepieces.

For the case of piggyback photography, the camera and lens sit on the main telescope. For a 50mm (wide angle) lens, the proper guiding magnification is thus 8-12X. If you use a 8" f/10 Schmidt-Cassegrain, for example, a 12mm guiding eyepiece yields 167X. Thus the star could drift 10 box diameters (box formed by the dual crosslines) and you would still get a good photo. For a 300mm lens,  $300\text{mm}/4\text{mm} = 75\text{X}$ . Thus at 167X the star could drift up to 2 box diameters and still yield a good photo. Clearly piggyback photography has a greater margin for error, and is highly recommended for initial astrophotography.



## PRECAUTIONS

1. To avoid running your automobile battery down operate only from a totally separate and portable battery.
2. Clock drive motors will run to rather low input voltages, but require full voltage typically to start. Therefore, if you have run the unit for some time dropping the battery voltage; and the unit is shut off and subsequently turned back on the clock drive motor may not restart. In this event shut the unit off and call it a night. However, if the unit had been left on, the restarting problem does not occur.
3. The ON-OFF switch on the front panel only controls the DC voltage and not the AC primary voltage. Therefore if opening, removing the PC board, or servicing the unit MAKE certain the AC line and DC power cables are unplugged.
4. Do NOT leave the unit turned on without a clock drive motor plugged in for extended periods. The unit actually uses more power in this state and although the circuitry is not damaged, extended operation without the telescope drive motor can cause the transistors to over-heat causing cosmetic damage to the case.
5. Do NOT block the ventilation slots on the unit, or overheating could result. For example placing the unit on a plush carpet, could prevent the required airflow through the unit.
6. Switch Pods are NOT interchangeable from Dual to Digital or Digital to Dual. Digital Switch Pods are identified by a colored dot on the back.

## DUAL STAR DRIVE

### C a b l i n g

1. Plug the DC POWER CABLE into a cigar lighter and into the 12 VDC inlet or plug the AC POWER CABLE into a 120 VAC outlet and into 120 VAC inlet. If both are plugged in, the unit will automatically and instantly transfer to battery power in the event of an AC power failure.
2. Plug the SWITCH POD into the SWITCH POD jack.
3. Plug the telescope clock drive motor into the POLAR DRIVE outlet.
4. Plug the DECLINATION CABLE from the telescope drive motor into the DEC DRIVE outlet.
5. Plug the optional MAP LED in.

### O p e r a t i o n

Turn the POWER switch ON by sliding the switch handle to the right. Set the VERNIER control to zero. At the zero position the REFERENCE LED should flash very slowly being either on or off for long periods.

Pressing WEST on the Switch Pod will speed the drive from 60 Hz to 80 Hz, increasing the relative speed by 5 arc seconds per second. The REFERENCE LED will flash rapidly. Pressing EAST will slow the drive from 60 Hz to 40 Hz, decreasing the relative speed by 5 arc seconds per second. The REFERENCE LED will again flash rapidly indicating corrective input. The VERNIER can also be used for tracking on other celestial objects by fine adjustment. The rate for the moon is about MINUS 2-3.

Pressing NORTH on the Pod should drive the telescope North. Press SOUTH on the Pod; the telescope should

drive to South. If just the reverse happens the gearing in your motor probably has one stage more or less than others. Or if you use an image erecting prism the directions may be reversed also. On German Equatorial Mounts this also happens when you switch the telescope from the West to East side of the sky. To correct for this simply requires reversing the REVERSE switch on the back panel.

The controls are simple and straightforward, basically you press the switch for the direction you want the star in the eyepiece to move. A few minutes, however, should be spent guiding with the slow motion controls to familiarize yourself their effect on the movement of a star before doing any astrophotography.

### C a l i b r a t i o n

Calibration is accomplished as follows: First insure that the unit has reached operating temperature by letting it run for about half an hour with the cover on before calibrating. Use a small AC clock with sweep second hand plugged into the POLAR DRIVE outlet. A second clock with a sweep second hand plugged into household AC or a stop watch is used as a reference to time the clock running from the unit.

Set the front panel VERNIER to zero. Open the unit to gain access to R10. With the cover off, the unit will cool down slowly over a few minutes giving time to make the adjustment. Exercise care not to touch anything except R10 with the cover off since hazardous voltage is present. Adjust R10 for the test clock plugged into the POLAR DRIVE to equal 60 seconds on the reference. The LED should zero out at the correct point.

## Circuit Description

Input voltage of 12 VDC goes through circuitry protection fuse F1, (3A), reverse voltage protection diode CR4, to the power switch S1, to over voltage spike protector diode CR1, (1N4751), filter C1, (2200 UF), and into voltage regulator U4 (78L08). For 120 VAC operation the input voltage goes through circuitry protection fuse F2 (.5A), to step down transformer T2, (PC-16-1500). The output of T2 is full wave rectified by diodes CR2, CR3, CR5, and CR6. Capacitor C1, (2200 UF), filters the rectified voltage into a smooth DC voltage which is then connected to the power switch as if 12 VDC were in use.

U4 supplies all power required for the timing and frequency control circuit. Its output voltage of 8V insures that voltage variations at the input do not effect the output frequency. The output is filtered by C2, (470 UF), and supplied to U1, U2, and U3.

Integrated circuit U2, (LM555), is the main oscillator and generates the basic timing for the output frequency desired. One percent timing components minimize temperature drift. Vernier R2, (50K), varies the output from 110 to 130 Hz. West switch when pressed parallels R2 and R3, (78.7K), with R1, (107K), dropping the resistance to 58K ohms nominal. This increases the frequency to 160 Hz. East switch when pressed parallels C5, (.047 UF), with C4, (.022 UF), increasing the capacitance to .069UF. This decreases the frequency to 80 Hz. R4, (66.5K), is part of the timing circuit and C6, (.022 UF), stabilizes U3. R10, (50K), is used to calibrate the zero mark on the front panel at 60 Hertz.

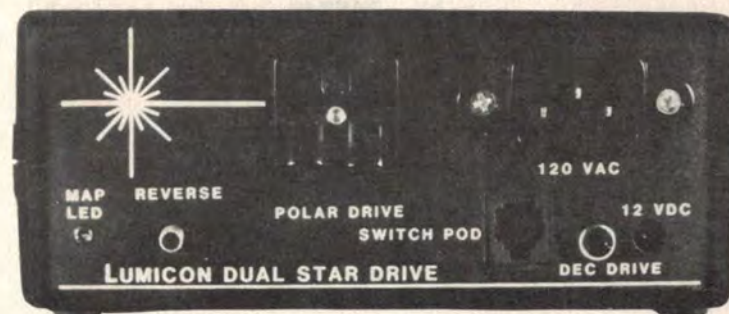
The output of U2 is divided by 2 by integrated circuit U3 (74C74) and made into symmetrical drive waveforms. This drive is applied through resistors R5 and R6, (10K), to power FET transistors Q1, Q3, (VN10LM), and to bipolar switching transistors Q2, and Q4, (2N4240), as a Darlington push pull drive for the input of transformer T1, (PC-20-1200). Capacitor C7, (.47 UF), suppresses switching noise and smooths the input to T1.

Transformer T1 steps the voltage up to 120 VAC at its output. Capacitor C8, (.47 UF), suppresses switching noise and smooths the output of T1. The output is fused by F4, (.5A), for over current and supplied to outlet J6 for connection to the drive motor.

Capacitors C9, (33 PF), and C3, (10 PF), and resistor R7, (10M), bias crystal Y1 into oscillation at a frequency of 3.579545 MHz. Integrated circuit U1, (MM5369), divides this by 59659 to produce a reference frequency of 60.0000 Hz. This reference is applied to the second half of U3, (74C74). The difference between the reference frequency and half the output frequency of U2, (LM555), is determined. This difference, (Beat Signal), is used to light the indicator REFERENCE LED CR5.

Relays K1 and K2 supply the power for the declination motor and provide dynamic braking to stop the motor quicker. The output current is protected by F3 (.5A). Reversing switch S2 exchanges the input control to the relays.

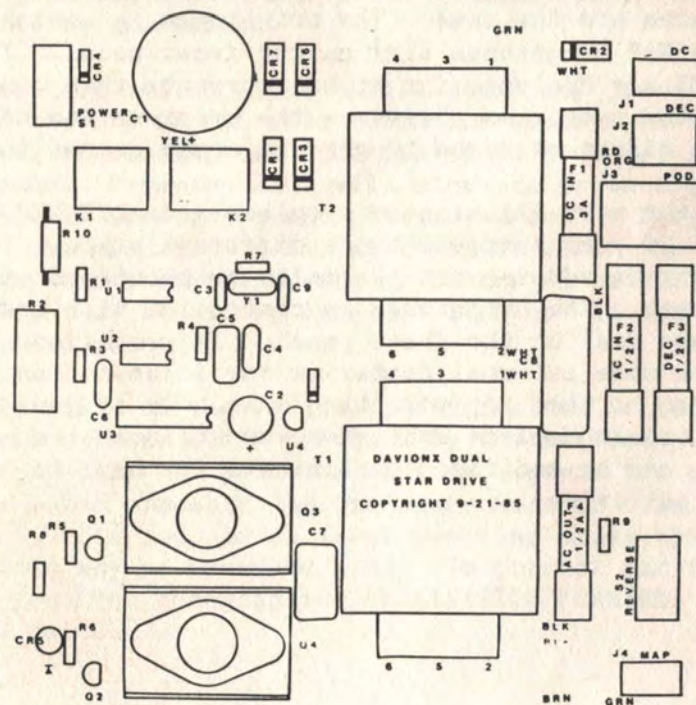
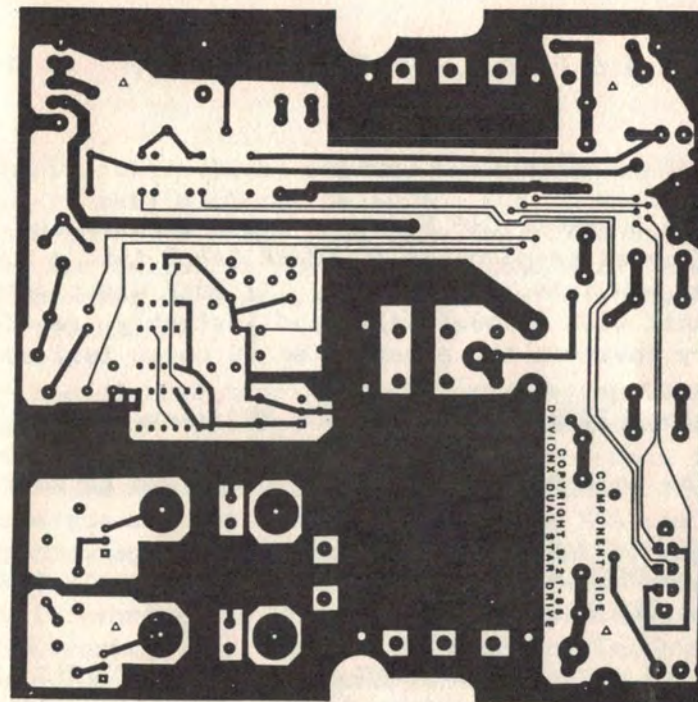
Lumicon Dual Star Drive Back Panel



# P a r t s L i s t

|                |                             |   |
|----------------|-----------------------------|---|
|                | BOARD, PC STAR DRIVE        | 1 |
|                | BOARD, PC SWITCH POD        | 1 |
|                | BOX, SWITCH POD             | 1 |
|                | BOX, STAR DRIVE             | 1 |
|                | BRACKET, TRANSFORMER        | 2 |
|                | BUSHING, LED                | 2 |
|                | CABLE, AC LINE              | 1 |
|                | CABLE, DC POWER W PLUG      | 1 |
|                | CABLE, TIE                  | 1 |
|                | CABLE, 6 COND FLAT          | 1 |
| C3             | CAP, 10PF                   | 1 |
| C9             | CAP, 33PF                   | 1 |
| C4, C6         | CAP, .022UF 100V 5%         | 2 |
| C5             | CAP, .047UF 100V 1%         | 1 |
| C8             | CAP, .47UF 400V 10%         | 1 |
| C7             | CAP, .47UF 100V 10%         | 1 |
| C2             | CAP, 470UF 16V              | 2 |
| C1             | CAP, 2200 UF 25V            | 1 |
| Y1             | CRYSTAL, 3.58MHZ            | 1 |
| CR1            | DIODE, 1N4751 (30 V. Zener) | 1 |
| CR2, CR3, CR4, |                             |   |
| CR5, CR6       | DIODE, 2.5A 50V             | 5 |
| CR7            | DIODE, LED RED              | 1 |
|                | FEET, STICK ON              | 4 |
| F1             | FUSE, 3 A                   | 1 |
| F2, F3, F4     | FUSE, 1/2 A                 | 3 |
|                | HEATSINK, TO-66 TOP         | 2 |
|                | HEATSINK, TO-66 BOTTOM      | 2 |
|                | HOLDER, FUSE CLIP           | 8 |
| U3             | IC, 74C74N                  | 1 |
| U2             | IC, LM555CN                 | 1 |
| U4             | IC, LM78L08CT               | 1 |
| U1             | IC, MM5369N                 | 1 |
|                | INSULATOR, SIL PAD          | 2 |
| J5             | JACK, AC INLET              | 1 |
| J6             | JACK, AC OUTLET             | 1 |
| J1             | JACK, DC POWER              | 1 |
| J2             | JACK, DEC RCA               | 1 |
| J4             | JACK, MAP 2.1MM             | 1 |

|                    |                         |   |
|--------------------|-------------------------|---|
| J3                 | JACK, 6 PIN MODULAR     | 1 |
| J3                 | PLUG, 6 PIN MALE        | 1 |
|                    | JACK, DIN 6 PIN MALE    | 1 |
|                    | KNOB, 1"                | 1 |
|                    | LOCKWASHER, #4          | 2 |
|                    | LOCKWASHER, #6          | 4 |
|                    | MANUAL, INSTRUCTION     | 1 |
|                    | NUT, 4-40 1/4" HEX      | 2 |
|                    | PANEL, BACK             | 1 |
|                    | PANEL, FRONT            | 1 |
|                    | PANEL, SWITCH POD       | 1 |
|                    | PLUG, CIGAR LIGHTER     | 1 |
|                    | POT, 50K CALIBRATION    | 1 |
|                    | POT, 50K VERNIER        | 1 |
|                    | RELAY 12V SPDT          | 2 |
| R10                |                         |   |
| R2                 |                         |   |
| K1, K2             |                         |   |
| R9                 | RESISTOR, 560 1/4W 5%   | 1 |
| R8                 | RESISTOR, 1.0K 1/4W 5%  | 1 |
| R5, R6             | RESISTOR, 10K 1/4W 5%   | 2 |
| R4                 | RESISTOR, 66.5K 1/4W 1% | 1 |
| R3                 | RESISTOR, 78.7 1/4W 1%  | 1 |
| R1                 | RESISTOR, 107K 1.4W 1%  | 1 |
| R7                 | RESISTOR, 10M 1/4W 5%   | 1 |
|                    | SCREW, 4-40 X 3/16"     | 8 |
|                    | SCREW, 4-40 X 1/4"      | 4 |
|                    | SCREW, 4-40 X 3/8" FLAT | 2 |
|                    | SCREW, 6-32 X 3/8"      | 4 |
|                    | SCREW, 6-32 X 1 1/2"    | 2 |
|                    | SOCKET, IC 8 PIN        | 2 |
|                    | SOCKET, IC 14 PIN       | 1 |
| S1, S2             | SWITCH, PC SLIDE        | 2 |
| S3, S4, S5, S6     | SWITCH, PC PUSHBUTTON   | 4 |
| T1                 | TRANSFORMER, PC-16-1500 | 1 |
| T2                 | TRANSFORMER, PC-20-1200 | 1 |
| Q1, Q3 (Power FET) | TRANSISTOR, VN10LM      | 2 |
| Q2, Q4             | TRANSISTOR, 2N4240      | 2 |



# D I G I T A L   Q U A R T Z   S T A R   D R I V E

## C a b l i n g

1. Plug the DC POWER CABLE into a cigar lighter and into the 12VDC inlet or plug the AC POWER CABLE into a 120 VAC outlet and into 120VAC inlet. If both are plugged in, the unit will automatically and instantly transfer to battery power in the event of an AC power failure.
2. Plug the SWITCH POD into SWITCH POD jack.
3. Plug the telescope clock drive motor into POLAR DRIVE outlet.
4. Plug the DECLINATION CABLE from the telescope drive motor into DEC DRIVE outlet.
5. Plug the optional MAP, DEC & RA SETTING CIRCLE LED's into J5, J6, & J7. The order is not important; all three jacks are the same. The brightness is controlled with the MAP brightness dial on the front panel. The three LED are designed for higher currents than most illuminated eyepieces therefore the eyepiece and MAP jack are different sized to prevent cross connections.
6. Plug the your illuminated eyepiece into EYE LED outlet. If your eyepiece has a different style connector, an adapter can generally be purchased at Radio Shack. The brightness is controlled with the EYE brightness dial on the front panel. If your finder telescope uses internal batteries for illumination this output can be used for something else. Or if you don't like having to replace batteries your illuminated eyepiece can be modified to eliminate the need to replace batteries.

## O p e r a t i o n

Turn POWER switch ON by sliding the switch handle to the right. If only a single Celestron SC8 or Meade 2080 size telescope is being used turn the POWER SAVER switch ON. If two Celestron SC8 or Meade 2080 size telescopes are being used or a single larger size turn the POWER SAVER switch OFF.

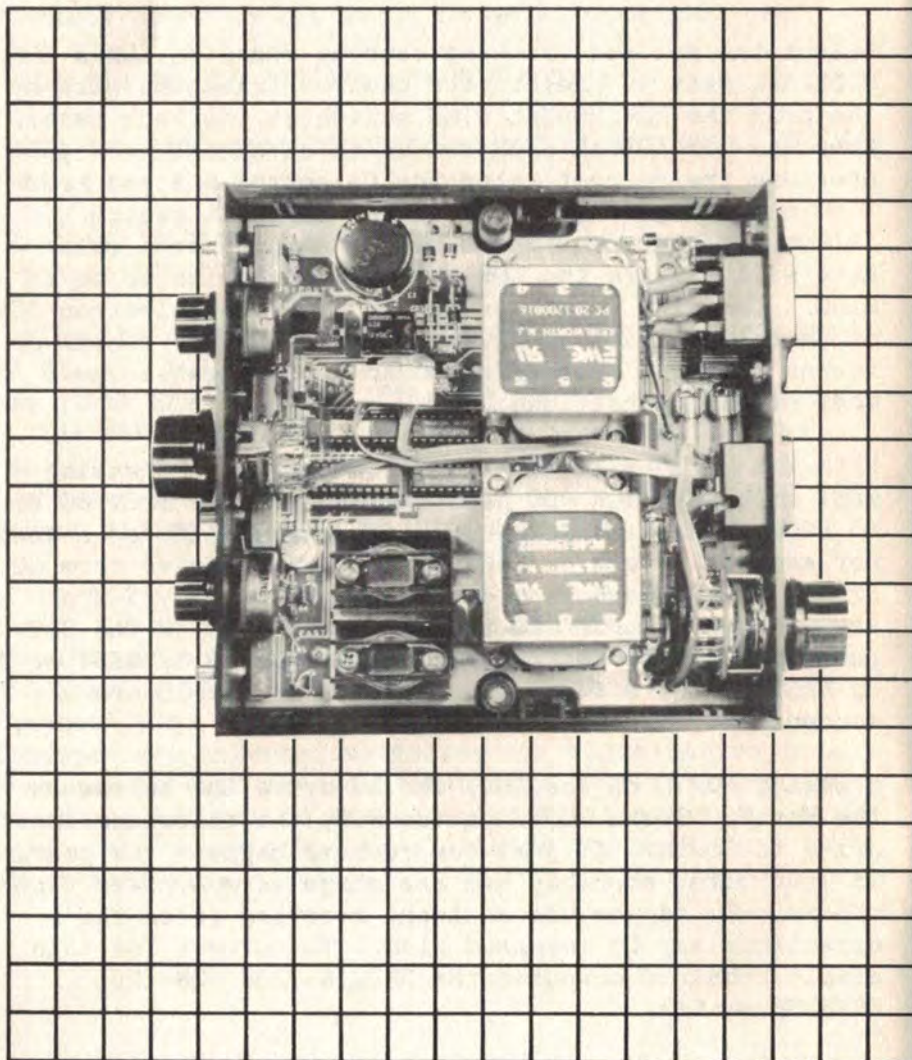
Select the desired tracking rate by changing LUNAR SOLAR SIDEREAL switch. Select the desired telescope rate by changing the LOW NORMAL HIGH switch on the back panel. When the LOW NORMAL HIGH switch is at NORMAL, the unit provides the correct rates for Celestron SC8 and Meade 2080 according to the LUNAR SOLAR SIDEREAL switch. Telescopes that require 60.000 Hz to produce a solar rate will require the LOW NORMAL HIGH switch to be in HIGH. Changing to either LOW or HIGH for Celestron SC8 or Meade 2080 will simply produce a slightly slower or faster tracking rate which could be desirable under some viewing conditions.

With the RATE switch in the GUIDE position, pressing WEST on the SWITCH POD will speed the drive from 60 Hz to 80 Hz; increasing the relative speed by 5 arc seconds per second. Pressing EAST will slow the drive from 60 Hz to 40 Hz, decreasing the relative speed by 5 arc seconds per second. If the RATE switch is in the SLEW position, the correcting rate is either 93 Hz WEST or 0 Hz EAST for an effective rate of +11.6 or -15 arc seconds per second.

Pressing NORTH on the POD; should drive the telescope to the North. Press SOUTH on the POD; the telescope should drive to South. If just the reverse happens the gearing in your motor probably has one stage more or less than others. Or if you use an image erecting prism the directions may be reversed also. To correct for this simply requires changing the DECLINATION FORWARD-REVERSE switch.

The controls are simple and straightforward, basically you press the switch for the direction you want the star in the eyepiece to move. A few minutes, however, should be spent guiding with the slow motion controls to familiarize yourself their effect on the movement of a star before doing any astrophotography.

*Lumicon Digital Quartz Star Drive Internal View*



## Circuit Description

Input voltage of 12 VDC at J1 goes through circuitry protection fuse F1, (3A), reverse voltage protection diode CR4, to the power switch S1, to over voltage spike protector diode CR1, (1N4751), filter C1, (6800 UF), and to voltage regulator U1 (7805) through R8. For 120 VAC operation the input voltage goes through circuitry protection fuse F2 (.5A), to step down transformer T1, (PC-20-1200). The output of T2 is full wave rectified by diodes CR2, CR3, CR5, and CR6. Capacitor C1, (2200 UF), filters the rectified voltage into a smooth DC voltage which is then connected to the power switch as if 12 VDC were in use.

U1 supplies all power required for the quartz crystal oscillator and frequency control circuit. The output is filtered by C3, (470 UF), and supplied to U2, U3, U4 and U5.

Integrated circuits U2 and U3 are the main oscillator and control circuit to generate the basic timing for the output frequency desired. These two IC's are custom made for Lumicon and accept inputs from the SWITCH POD, GUIDE SLEW, LOW NORMAL HIGH, and LUNAR SOLAR SIDEREAL switches to yield outputs for U4 and U5. Integrated circuits U4 and U5 are counters that divide the crystal frequency as required to produce the desired output frequency.

Two outputs of U3 are symmetrical drive waveforms. This drive is applied through resistors R3 and R5, (10K), to power FET transistors Q1, Q3, (VN10LM), and to bipolar switching transistors Q2, and Q4, (2N4240), as a Darlington push pull drive for the input of transformer T2, (PC-16-1500). Capacitor C7, (.47 UF), suppresses switching noise and smooths the input to T2.

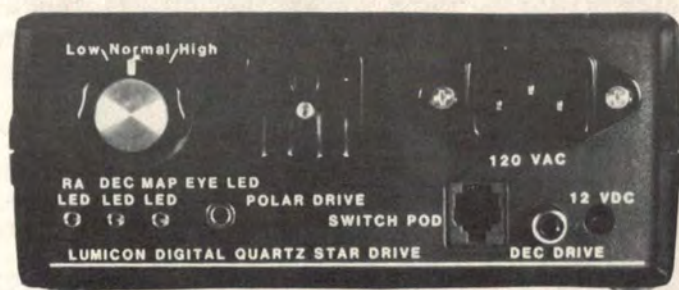
Transformer T2 steps the voltage up to 120 VAC at its output. Capacitor C5, (.47 UF), suppresses switching noise and smooths the output of T2. The output is fused by F4, (.5A), for over current and supplied to outlet J9 for connection to the clock drive motor.

Capacitor C2, (100 PF) and resistor R2, (150K), bias crystal Y1 into oscillation at a frequency of 3.579545 MHz.

Pots R3 and R1 pick off 5V and 12V for the LED's. R6 is a current limiting resistor as R7. The diodes CR9, CR10, CR11 permit operation of the serial LED's with only one LED plugged in. Without the diodes, all three LED's would need to be installed for only one to light.

Relays K1 and K2 supply the power for the declination motor and provide dynamic braking to stop the motor quicker. The output current is protected by F3 (.5A). Reversing switch S3 exchanges the input control to the relays.

#### *Lumicon Digital Quartz Star Drive Back Panel*

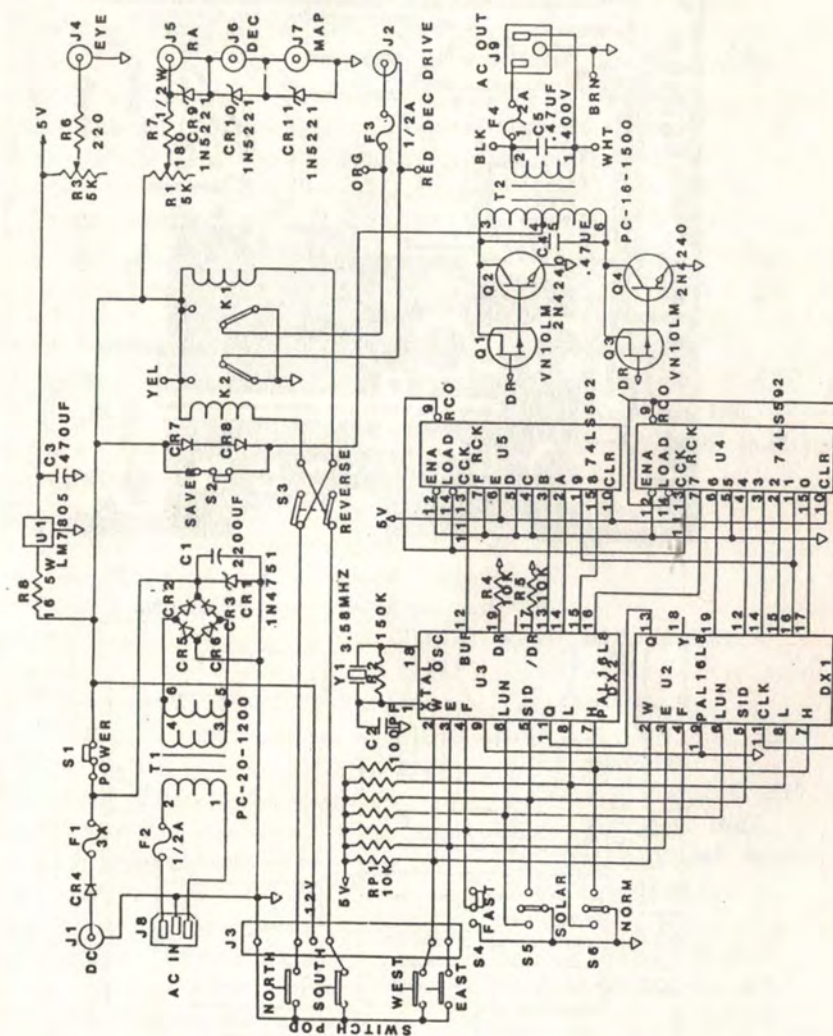


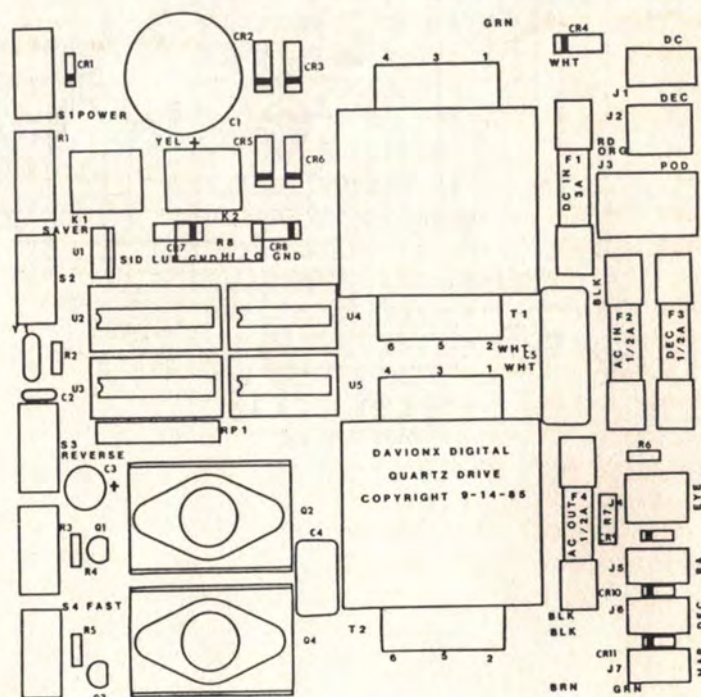
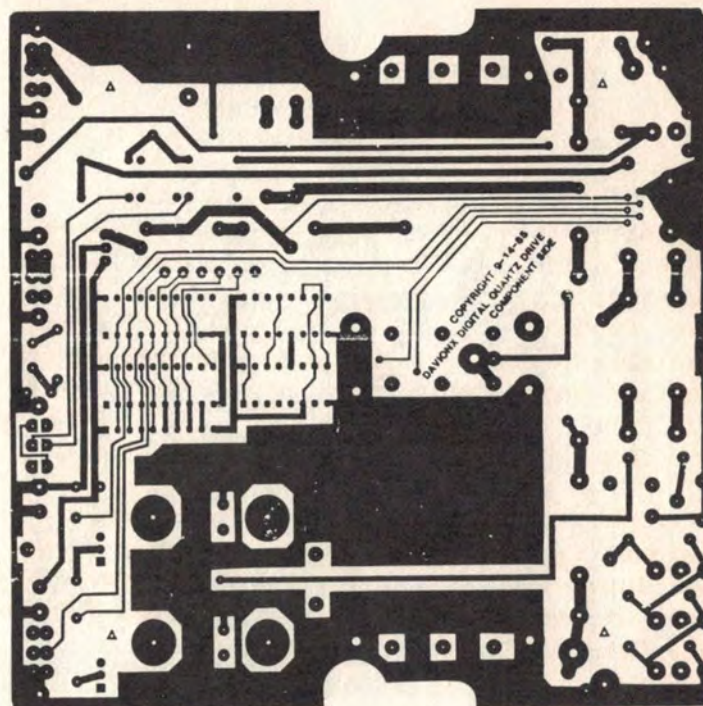
#### *Parts List*

|                     |                        |   |
|---------------------|------------------------|---|
|                     | BOARD, PC QUAR6Z DRIVE | 1 |
|                     | BOARD, PC SWITCH POD   | 1 |
|                     | BOX, SWITCH POD        | 1 |
|                     | BOX, STAR DRIVE        | 1 |
|                     | BRACKET, TRANSFORMER   | 2 |
|                     | BUSHING, LED           | 1 |
|                     | CABLE, AC LINE         | 1 |
|                     | CABLE, DC POWER W PLUG | 1 |
|                     | CABLE, TIE             | 1 |
|                     | CABLE, 6 COND FLAT     | 1 |
| C2                  | CAP, 100PF             | 1 |
| C5                  | CAP, .47UF 400V 10%    | 1 |
| C4                  | CAP, .47UF 100V 10%    | 1 |
| C3                  | CAP, 470UF 16V         | 2 |
| C1                  | CAP, 2200 UF 25V       | 1 |
| Y1                  | CRYSTAL, 3.58MHZ       | 1 |
| CR1                 | DIODE, 1N4751          | 1 |
| CR2, CR3, CR4, CR5, | DIODE, 2.5A 50V        | 7 |
| CR6, CR7, CR8       |                        |   |
| CR9, CR10, CR11     | DIODE, IN5221          | 3 |
|                     | FEET, STICK ON         | 4 |
| F1                  | FUSE, 3 A              | 1 |
| F2, F3, F4          | FUSE, 1/2 A            | 3 |
|                     | HEATSINK, TO-66 TOP    | 2 |
|                     | HEATSINK, TO-66 BOTTOM | 2 |
|                     | HEATSINK, TO-220       | 1 |
|                     | HOLDER, FUSE CLIP      | 8 |
| U1                  | IC, LM7805             | 1 |
| U2                  | IC, DX1                | 1 |
| U3                  | IC, DX2                | 1 |
| U4                  | IC, 74LS592            | 1 |
| U5                  | IC, 74LS592            | 1 |
|                     | INSULATOR, SIL PAD     | 2 |
| J8                  | JACK, AC INLET         | 1 |
| J9                  | JACK, AC OUTLET        | 1 |
| J1                  | JACK, DC POWER         | 1 |
| J2                  | JACK, DEC RCA          | 1 |
| J4                  | JACK, EYE 3.1MM        | 1 |
| J5, J6, J7          | JACK, MAP 2.1MM        | 3 |
| J3                  | JACK, 6 PIN MODULAR    | 1 |
|                     | PLUG, 6 PIN MALE       | 1 |

|                 |                         |   |
|-----------------|-------------------------|---|
|                 | KNOB, 3/4"              | 2 |
|                 | KNOB, 5/8"              | 2 |
|                 | LOCKWASHER, #4          | 3 |
|                 | LOCKWASHER, #6          | 4 |
|                 | MANUAL, OWNER'S         | 1 |
|                 | NUT, 4-40 1/4" HEX      | 3 |
|                 | PANEL, BACK             | 1 |
|                 | PANEL, FRONT            | 1 |
|                 | PANEL, SWITCH POD       | 1 |
|                 | PLUG, CIGAR LIGHTER     | 1 |
| R1              | POT, 5 K                | 1 |
| R3              | POT, 5 K                | 1 |
| K1, K2          | RELAY 12V SPDT          | 2 |
| R4, R5          | RESISTOR, 10K 1/4W 5%   | 2 |
| R6              | RESISTOR, 220 1/4W 5%   | 1 |
| R7              | RESISTOR, 180 1/2W 5%   | 1 |
| R8              | RESISTOR, 16 5 W 5%     | 1 |
| R2              | RESISTOR, 150K 1/4W 5%  | 1 |
| RP1             | RES PAK, 10K            | 1 |
|                 | SCREW, 4-40 X 3/16"     | 8 |
|                 | SCREW, 4-40 X 1/4"      | 4 |
|                 | SCREW, 4-40 X 3/8"      | 1 |
|                 | SCREW, 4-40 X 3/8" FLAT | 2 |
|                 | SCREW, 6-32 X 3/8"      | 4 |
|                 | SCREW, 6-32 X 1 1/2"    | 2 |
|                 | SOCKET, IC 16 PIN       | 2 |
|                 | SOCKET, IC 20 PIN       | 2 |
| S1, S2, S3, S4  | SWITCH, PC SLIDE        | 4 |
| S5, S6          | SWITCH, ROTARY          | 2 |
| S7, S8, S9, S10 | SWITCH, PC PUSHBUTTON   | 4 |
| T1              | TRANSFORMER, PC-20-1200 | 1 |
| T2              | TRANSFORMER, PC-16-1500 | 1 |
| Q1, Q3          | TRANSISTOR, VN10LM      | 2 |
| Q2, Q4          | TRANSISTOR, 2N4240      | 2 |

# S c h e m a t i c





## SPECIFICATIONS

### Switch Pod & Cables

|                                  |                   |
|----------------------------------|-------------------|
| Weight. . . . .                  | 1 ounce           |
| Dimensions. . . . .              | 1.8L x 1.4W x .7H |
| Switch Pod Cable. . . . .        | 6 feet 6-wire     |
| AC Power Cable. . . . .          | 6 feet 3-wire     |
| DC Power Cable. . . . .          | 12 feet 2-wire    |
| LED Cable. . . . .               | 6 feet 2-wire     |
| Declination Motor Cable. . . . . | 6 feet 2-wire     |

### Dual Star Drive

|                                  |                           |
|----------------------------------|---------------------------|
| Weight. . . . .                  | 3.25 pounds               |
| Dimensions. . . . .              | 2.5H x 6.1W x 6.25D       |
| Voltage Input. . . . .           | 12 VDC or 120 VAC         |
| Voltage Out Declination. . . . . | +/-12 VDC @ 500mA nominal |
| Voltage Out. . . . .             | 120 VAC                   |
| Power Out. . . . .               | 10 Watts                  |
| Vernier Range. . . . .           | 55 to 65 Hz.              |
| Correction West. . . . .         | 80 Hz.                    |
| Correction East. . . . .         | 40 Hz.                    |
| Stability. . . . .               | 0.5% per degree C         |

### Digital Star Drive

|                                       |                           |
|---------------------------------------|---------------------------|
| Weight. . . . .                       | 3.25 pounds               |
| Dimensions. . . . .                   | 2.5H x 6.1W x 6.25D       |
| Voltage Input. . . . .                | 12 VDC or 120 VAC         |
| Voltage Out Declination. . . . .      | +/-12 VDC @ 500mA nominal |
| Voltage Out. . . . .                  | 120 VAC nominal           |
| Power Out. . . . .                    | 15 Watts                  |
| Solar Output Frequency. . . . .       | 59.832 Hz. +/-0.05%       |
| Sidereal Output Frequency. . . . .    | 60.000 Hz. +/-0.05%       |
| Lunar Output Frequency. . . . .       | 57.809 Hz. +/-0.05%       |
| Correction West Normal Speed. . . . . | 80.000 Hz. +/-0.05%       |
| Correction East Normal Speed. . . . . | 40.000 Hz. +/-0.05%       |
| Correction West Fast Speed. . . . .   | 93.00 Hz. +/-0.05%        |
| Correction East Fast Speed. . . . .   | 0.000 Hz. +/-0.05%        |
| Stability. . . . .                    | 0.005% per degree C       |

## S E R V I C E

In the event that the unit malfunctions, carefully pack the entire unit in the original package with a description of the trouble and ship it freight pre-paid to:

Lumicon  
2111 Research Drive  
Livermore, Calif. 94550

Labor and parts are covered during the first 1 year. After 1 year, the charge is \$35.00 for labor; plus the cost of replacement parts.

\* \* \* \* \*

\* W A R R A N T Y \*

\* The Lumicon Dual Star Drive carries a 1 year \*

\* guarantee on parts and workmanship from date \*

\* of purchase. This warranty shall not apply to \*

\* any malfunction, which in the opinion of \*

\* Lumicon is the result of abusive use, \*

\* accident, willful destruction, improper or \*

\* unauthorized repair or installation. This \*

\* warranty does not cover any subsequent loss \*

\* caused by a malfunction of the Lumicon Dual \*

\* Star Drive. All service under this warranty \*

\* must be performed by returning the unit, \*

\* freight pre-paid, to Lumicon, 2111 Research \*

\* Drive, Livermore, CALIF. with proof of \*

\* purchase date. In addition Lumicon is not \*

\* liable for any intended use, or misuse of the \*

\* Lumicon Dual Star Drive. Lumicon will at its \*

\* own discretion, repair or replace any unit \*

\* returned under this warranty. No other \*

\* warranties are expressed or implied. \*

\* \* \* \* \*